Rapid Deterioration of Basic Life Support Skills in Dentists With Basic Life Support Healthcare Provider

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The aim of this study was to investigate the correlation between basic life support skills in dentists who had completed the American Heart Association's Basic Life Support (BLS) Healthcare Provider qualification and time since course completion. Thirty-six dentists who had completed the 2005 BLS Healthcare Provider course participated in the study. We asked participants to perform 2 cycles of cardiopulmonary resuscitation on a mannequin and evaluated basic life support skills. Dentists who had previously completed the BLS Healthcare Provider course displayed both prolonged reaction times, and the quality of their basic life support skills deteriorated rapidly. There were no correlations between basic life support skills and time since course completion. Our results suggest that basic life support skills deteriorate rapidly for dentists who have completed the BLS Healthcare Provider. Newer guidelines stressing chest compressions over ventilation may help improve performance over time, allowing better cardiopulmonary resuscitation in dental office emergencies. Moreover, it may be effective to provide a more specialized version of the life support course to train the dentists, stressing issues that may be more likely to occur in the dental office.

Cardiopulmonary resuscitation (CPR) is a core skill that all health care professionals are advised to master. Recent studies on the efficacy of CPR have suggested that the best immediate means of achieving resuscitation in cardiac arrest are high-quality CPR performed with minimal interruptions and early defibrillation.[1] Basic life support (BLS), including the use of an automated external defibrillator (AED), is one of the basic skills necessary for the management of emergencies in dental practice. Many textbooks and articles on dental emergencies recommend that dentists should be certified in BLS and provide appropriate life support for emergencies that occur in the dental office.[2–5]

Basic life support education has become almost universal in dental schools; however, the adequacy of training programs differs from one country to another and from one dental school to another.[6,7] According to a previous report on changes to medical emergency education in US dental schools, special attention was given to changes in technology (pulse oximetry and AEDs), teaching methods (audiovisual, role-playing, and simulation), and subject matter (CPR, venipuncture, and endotracheal intubation) that affect medical emergency education. Furthermore, CPR certification/recertification for both students and faculty members was not provided at 3 of the reporting US dental schools.[6] This report concluded that the standardization of medical

emergency education is required to ensure an appropriate level of training for all dental students.[6] In a previous report on students' attitudes and self-assessment regarding emergency medical care and its practical application, 40 dental students in their last 2 years of study registered for an emergency medical care course.[7] This report concluded that considerable enhancement of self-confidence in performing emergency medical care techniques may lead to an increased willingness to manage emergencies.[7] Therefore, the core components of education regarding medical emergencies, including CPR for dentists, should be standardized.

The BLS Healthcare Provider (BLS-HCP) courses designed by the American Heart Association (AHA) are standardized worldwide and held frequently in Japan. According to a previous report that evaluated the impact of the AHA-certified BLS and advanced cardiac life support provider courses on CPR outcomes in a tertiary care hospital, formal certified BLS and advanced cardiac life support training for health care professionals lead to definitive improvement in resuscitation outcomes.[8] Therefore, BLS-HCP courses may be an effective means of teaching necessary skills for the management of emergencies in dental practice. Many Japanese dentists have attended this course and attained the BLS-HCP qualification; however, their BLS proficiency may lessen over time, as there are few opportunities to use these skills in the dental office. In addition, we speculate that most dentists may not perform ideally when confronted with medical emergencies.

The aim of this study was to investigate BLS skill levels in dentists who had attained the HCP qualification and the correlation between these skills and time since course completion. To our knowledge, no studies have been conducted on dentists' BLS-HCP skills. The AHA recommends that BLS-HCP skill performance be assessed during a 2-year certification period with reinforcement provided as required.[9] However, the optimal timing and method for reassessment and reinforcement for BLS-HCP are not known.[9]

METHODS

Participants were dentists who had completed the BLS-HCP qualification (HCPDs) using the 2005 AHA guidelines at Fukuoka Dental College. The ethics committee at Fukuoka Dental College determined that ethical approval was not required for this study. Thirty-five HCPDs participated in the study (22 men and 13 women; aged 30 ± 6.2 years [mean $\pm$ SD]) between January 2008 and January 2009. They were informed that their participation was entirely confidential and they could withdraw from the study at any time. Written informed consent was obtained from all participants.

We prepared a mannequin connected to Laerdal PC SkillReporting System computer software, which evaluated participants' BLS skills. Participants were individually directed to a room and were not provided with any information regarding the experiment. They were informed that "the patient collapsed suddenly in the dental office just now." We asked participants to perform 2 cycles of single-rescuer adult CPR and evaluated the quality of their skills (check response, activate the emergency response system and obtain an AED, open the airway, check for breathing, rescue breathing, check for a pulse, and chest compression according to 2005 guidelines). Continuous variables (time to check for breathing, time to chest compression, time to interruption of chest compression, and rate of chest compression) were also measured. Skill quality definitions mirrored those of the 2005 BLS-HCP course.

"Check response" was defined as "tap the mannequin's shoulder and shout to confirm the victim's condition." "Send second rescuer to activate the emergency response system and obtain an AED" was defined as "point at a second rescuer, and send him or her to call 911 and obtain an AED." "Open the airway" was defined as "perform a head tilt-chin lift maneuver." "Check for breathing" was defined as "place the ear near the mannequin's mouth and nose, look for the rise and fall of the chest, listen for air escaping during exhalation, and feel for the flow of air against the cheek" and "take at least 5 seconds and no more than 10 seconds to check for breathing." "Rescue breathing" was defined as "pinch the nose closed with the thumb and index finger, perform two cycles of mouth-to-mouth breathing, watch for the chest rise, and blow for one second." "Check for pulse" was defined as "palpate the carotid artery, using two or three fingers for at least 5 seconds and no more than 10 seconds." "Chest compression" was defined as "put the heel of one hand on the center of the mannequin's chest between the nipples, push hard and fast, and press down 1.5 to 2 inches with each compression. At the end of each compression, make sure the chest recoil is allowed to reexpand completely."

The depth and rate of chest compression, time to interruption of chest compression, time to check for breathing, and time to chest compression were registered for each participant. "Time to interruption of chest compression" was defined as "the interruption time for first and second cycles of CPR," "time to check for breathing" was defined as "the time from attempting to open the airway to completing the check for breathing," and "time to chest compression" was defined as "the time from check response to first chest compression."

The BLS skills were assessed using the software described above and an AHA BLS instructor. Data for "chest compression" and "rescue breathing" were collected and reviewed using Laerdal PC SkillReporting

Table 1. Time Since Completion of Healthcare Provider Course and Number of Health Care Providers Who Were Able to Perform Basic Life Support Skills Correctly*

Time Since Course Completion, mo	Total, n	Check Response, n	Call 911 and Get an Automated External Defibrillator, n	Open the Airway, n	Check for Breathing, n	Rescue Breathing, n	Check for Pulse, n	Chest Compression, n
5	12	12	11	4	3	2	4	7
10	3	3	3	1	0	0	2	1
12	3	3	3	2	2	1	1	2
19	3	3	2	2	1	2	3	2
21	2	2	2	2	2	1	2	2
24	12	12	11	8	7	4	7	9

 * Almost all subjects were able to perform the "check response" and "call 911 and obtain an AED" skills. However, very few subjects performed the "open the airway," "check for breathing," and "rescue breathing" skills correctly.

System software, which was connected to the mannequin. "Rescue breathing" was evaluated as successful on completion of 2 breaths. "Chest compression" was evaluated as successful on completion of 24 compressions (80%). The other data were assessed and measured by an AHA BLS instructor according to the definitions mentioned above. We recorded the number of skills that participants were able to perform and measurement values for the continuous variables. Moreover, we analyzed correlations between time since BLS-HCP course completion, skill quality, and the continuous variables, as there was a possibility that deterioration of BLS skill quality would be associated with time since course completion.

Skill quality data were calculated using the number of participants who were able to perform CPR correctly. All statistical calculations were performed using SPSS version 20 (SPSS Inc, Chicago, Ill). Correlations were analyzed using nonparametric analysis and covariance analysis. To evaluate correlations between skill quality and time since course completion, Pearson's correlation coefficient was used. Correlation coefficients ranged from ±0.40 to ±1.00, with P values of <.05 accepted as significant.

RESULTS

Participants' average time since course completion was 14 ± 6.0 months (mean ± SD). The results of the skill quality analysis are shown in Table 1. Participants' skills related to breathing tended to deteriorate. Almost all participants were able to perform "check response" and "call 911 and obtain an AED" skills. However, very few were able to perform "open the airway," "check for breathing," and "rescue breathing" skills correctly.

Results for continuous variables are shown in Table 2. The depth of chest compression was almost appropriate (mean depth, 46.62 mm; range, 32–56 mm). However, the rate of chest compression was inconsistent (mean rate, 99.75 bpm; range, 68–137 bpm). The recommended time to interruption of chest compression is less than 10 seconds. However, the time of interruption of chest compressions of the participants was inconsistent (mean time, 13.21 seconds; range, 5–29 seconds). The recommended time to check for breathing is at least 5 seconds and no more than 10 seconds. However, time to check for breathing of the participants was inconsistent (mean time, 24.15 seconds; range, 10–119 seconds). The time it took participants to perform BLS skills (reaction times) was prolonged. However, no significant associations were found between time since course completion and continuous variables. Time since course completion was not correlated with skill quality (r = .14, P = .41).

DISCUSSION

Cardiac arrest could occur in a dental practice at any time, and all dentists should consider BLS training for themselves and their office staff to help manage serious medical complications in their patients, as there are several case reports of successful resuscitation.[10–13] However, the education of medical emergency training for dentists varies from one country to another. Moreover, dentists rarely use CPR skills. Therefore, in accordance with findings from previous studies on the CPR abilities, we suggest that there may be a need for periodic supervised retraining more frequently than every 2 years for dentists in dental practices.[5,14–16]

These results showed that the time taken to perform CPR (reaction times) was prolonged and the quality of CPR skills deteriorated rapidly when CPR was not performed regularly. In addition, there were no correlations between reaction times and time since course completion, which was not expected. One of the reasons for this result may be that the participants were dentists who were unlikely to use their BLS skills. Because most medical emergencies in dental practice, such as vasovagal reflex and hyperventilation, are generally not life threatening, management of cardiac arrest in dentistry is rare. Therefore, dentists may equate BLS skills with rarely used skills required in dental practice. However,

Table 2. Correlations Between Time Since Completion of the Healthcare Provider Course and Continuous HCPD Skills Variables*

Time Since Course Completion, mo	Depth of Chest Compression, mm (Mean ± SD)	Rate of Chest Compression, bpm (Mean ± SD)	Time to Interruption of Chest Compression, s (Mean ± SD)	Time to Check for Breathing, s (Mean ± SD)	Time to Chest Compression, s (Mean ± SD)
5	46.7 ± 7.5	98.1 ± 16.0	12.1 ± 2.2	27.0 ± 14.1	47.7 ± 18.9
10	41.6 ± 12.7	114.3 ± 23.0	13.2 ± 4.9	13.6 ± 4.0	30.7 ± 14.8
12	55.0 ± 1.7	103.0 ± 15.6	12.2 ± 1.5	28.7 ± 10.6	43.7 ± 8.3
19	47.6 ± 10.4	85.0 ± 16.0	17.7 ± 8.3	39.3 ± 32.0	60.6 ± 53.9
21	47.5 ± 0.7	106.0 ± 18.3	14.5 ± 7.8	15.0 ± 7.0	45.0 ± 7.0
24	47.0 ± 6.3	99.6 ± 8.9	13.0 ± 7.2	25.7 ± 29.5	48.9 ± 26.8

* Time since course completion was not correlated with depth of chest compression ($r = .11$, $P = .52$), rate of chest compression ($r = .15$, $P = .39$), time to interruption of chest compression ($r = .05$, $P = .78$), time to check for breathing ($r = .008$, $P = .96$), or time to chest compression ($r = .12$, $P = .22$).

cardiac arrest is the most critical threat to life, and dentists are advised that they should obtain BLS-related knowledge and skills at least every 2 years. According to our results, it is possible that 2 years is too long an interval for dentists to maintain their BLS skills recommended by the AHA without more frequent retraining. Basic CPR skills have been shown to deteriorate when assessed at 1.5–12 months in the medical personnel[17–19] and 2–6 months[20–23] in laypersons following the completion of training. Moreover, some studies have suggested that dentists' CPR knowledge and experience, including AED use, is inadequate,[24–26] and they should be better trained to respond to medical emergencies that occur in the dental office.[27–29] However, suggestions for participant characteristics, course length, course format, instructor type, and experience of participant involvement in actual resuscitation differ between these studies.

This study has shown that BLS skills in dentists who had completed the AHA BLS-HCP course according to the 2005 guidelines deteriorated rapidly. It is not clear, however, if there is a critical time interval from training to diminution in CPR skills. The data for all participants, irrespective of time since course completion, needed to be pooled because of the sample size. Future studies should look at skill deterioration in a unified fashion from shortly after initial certification, then at 6 months, 12 months, 18 months, and 24 months. This would have created a series of data that are more standardized and comparable.

Newby et al[30] suggested that realistic simulation training in the management of emergencies for dental students is an effective adjunct to traditional lecture style teaching. Therefore, it may be effective to revise the BLS course design to include realistic scenarios for dentists in order to help them retain resuscitation skills.

The participants in our study reflected the teaching methodologies used in the AHA course design that was updated in 2005. Approximately every 5 years, AHA experts review emerging scientific evidence and recent clinical experience and update the AHA guidelines for BLS. The AHA Guidelines for CPR and Emergency Cardiovascular Care were last updated in 2010 and are expected to be updated again in 2015. The current 2010 guidelines were designed to simplify rescuer training and emphasize the need to provide early chest compressions for victims of sudden cardiac arrest. Emphasis on chest compressions is the most critical concept in the revision of the AHA guidelines. In contrast, rescue breaths should be brief, because numerous studies have demonstrated that delays or interruptions in chest compressions to include rescue breaths reduce survival.[31] In our study, the number of participants whose rescue breathing skills had deteriorated was higher than the number of participants whose chest compression skills had deteriorated. Therefore, the skills emphasized in the new guidelines may be more suitable for those who seldom perform CPR, including dentists. Although this study used older guidelines, the methodology can be used in future studies, which should look at newer guidelines, and the results should be compared with this current study.

Skills in AED use are usually evaluated in studies such as this; however, we did not examine AED skills because AEDs include voice prompts to guide users. Moreover, according to the new AHA guidelines, use of an AED does not require training, although training does improve performance,[31] and mannequin-based studies have demonstrated that AEDs can be operated correctly without prior training.[32,33]

CONCLUSION

Reaction times were prolonged and the quality of BLS skills in dentists deteriorated quickly when CPR was not performed regularly. There were no correlations between deterioration of BLS skills and time since course completion. Therefore, we posit that dentists should update their BLS knowledge and skills periodically, at least every 2 years and preferably more frequently. Moreover, dentists should complete the BLS-HCP course according to the newest guidelines stressing chest

compressions over ventilation, which may improve CPR skills and provide BLS support for victims who collapse in the dental office.

REFERENCES

1. Scapigliati A, Ristagno G, Cavaliere F. The best timing for defibrillation in shockable cardiac arrest. *Minerva Anestesiol*. 2013;79:92–101.

2. Malamed SF. *Sedation: A Guide to Patient Management*. St Louis, Mo: Mosby; 1995.

3. Rosenberg M. Preparing for medical emergencies: the essential drugs and equipment for the dental office. *J Am Dent Assoc*. 2010;141(suppl 1):14S–19S.

4. Fast TB, Martin MD, Ellis TM. Emergency preparedness: a survey of dental practitioners. *J Am Diet Assoc*. 1986;112:499–502.

5. Macpherson LMD, Binnie VI. A survey of general anesthesia, sedation and resuscitation in general dental practice. *Br Dent J*. 1996;181:199–203.

6. Clark MS, Wall BE, Tholström TC et al. A twenty-year follow-up survey of medical emergency education in U.S. dental schools. *J Dent Educ*. 2006;70:1316–1319.

7. Sopka S, Biermann H, Druener S et al. Practical skills training influences knowledge and attitude of dental students towards emergency medical care. *Eur J Dent Educ*. 2012;16:179–186.

8. Sodhi K, Singla MK, Shrivastava A. Impact of advanced cardiac life support training program on the outcome of cardiopulmonary resuscitation in a tertiary care hospital. *Indian J Crit Care Med*. 2011;15:209–212.

9. Field JM, Hazinski MF, Sayre MR. Part 1: executive summary: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2010;122(18 suppl 3):S640–S656.

10. Findler M, Galili D. Cardiac arrest in dental offices: report of six cases. *Refuat Hapeh Vehashinayim*. 2002;19:79–87.

11. Chapman PJ, Perkeyman HW. Successful defibrillation of a dental patient in cardiac arrest. *Aust Dent J*. 2002;47:176–177.

12. Hunter PL. Cardiac arrest in the dental surgery. *Br Dent J*. 1991;170:284.

13. Absi EG. A cardiac arrest in the dental chair. *Br Dent J*. 1987;163:199–200.

14. Hussain I, Matthews RW, Scully C. Cardiopulmonary resuscitation skills of dental personnel. *Br Dent J*. 1992;173:173–174.

15. Chate RAC. Evaluation of a dental practice cardiopulmonary resuscitation training scheme. *Br Dental J*. 1996;181:416–420.

16. Fletcher JM, Kramer LD. An in-practice training scheme for cardiopulmonary resuscitation. *Br Dent J*. 1992;172:252–253.

17. Berden HJ, Willems FF, Hendrick JM et al. How frequently should basic cardiopulmonary resuscitation training be repeated to maintain adequate skills? *BMJ*. 1993;306:1576–1577.

18. Spooner BB, Fallaha JF, Kocierz L et al. An evaluation of objective feedback in basic life support (BLS) training. *Resuscitation*. 2007;73:417–424.

19. Smith KK, Gilcreast D, Pierce K. Evaluation of staff's retention of ACLS and BLS skills. *Resuscitation*. 2008;78:59–65.

20. Einspruch EL, Lynch B, Aufderheide TP, Nichol G, Becker L. Retention of CPR skills learned in a traditional AHA Heartsaver course versus 30-min video self-training: a controlled randomized study. *Resuscitation*. 2007;74:476–486.

21. Roppolo LP, Pepe PE, Campbell L, et al. Prospective, randomized trial of the effectiveness and retention of 30-min layperson training for cardiopulmonary resuscitation and automated external defibrillators: the American Airlines Study. *Resuscitation*. 2007;74:276–285.

22. Woollard M, Whitfeild R, Smith A, et al. Skill acquisition and retention in automated external defibrillator (AED) use and CPR by lay responders: a prospective study. *Resuscitation*. 2004;60:17–28.

23. Woollard M, Whitfield R, Newcombe RG, et al. Optimal refresher training intervals for AED and CPR skills: a randomised controlled trial. *Resuscitation*. 2006;71:237–247.

24. Boyd BC, Fantuzzo JJ, Votta T. The role of automated external defibrillators in dental practice. *NY State Dent J*. 2006;72:20–23.

25. Kandray DP, Pieren JA, Benner RW. Attitudes of Ohio dentists and dental hygienists on the use of automated external defibrillators. *J Dent Educ*. 2007;71:480–486.

26. Arsati F, Montalli VA, Flório FM, et al. Brazilian dentists' attitudes about medical emergencies during dental treatment. *J Dent Educ*. 2010;74:661–666.

27. Gonzaga HF, Buso L, Jorge MA, et al. Evaluation of knowledge and experience of dentists of São Paulo State, Brazil about cardiopulmonary resuscitation. *Braz Dent J*. 2003;14:220–222.

28. Haas DA. Preparing dental office staff members for emergencies: developing a basic action plan. *J Am Dent Assoc*. 2010;141(suppl 1):8S–13S.

29. Sangrik LJ. Medical emergencies: are you prepared? *Dent Today*. 2010;29:14, 16, 18.

30. Newby JP, Keast J, Adam WR. Simulation of medical emergencies in dental practice: development and evaluation of an undergraduate training programme. *Aust Dent J*. 2010;55:399–404.

31. Berg RA, Hemphill R, Abella BS, et al. Part 5: adult basic life support: 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2010;122:S685–S705.

32. Beckers SK, Fries M, Bickenbach J, et al. Retention of skills in medical students following minimal theoretical instructions on semi and fully automated external defibrillators. *Resuscitation*. 2007;72:444–450.

33. Gundry JW, Comess KA, DeRook FA, et al. Comparison of naive sixth-grade children with trained professionals in the use of an automated external defibrillator. *Circulation*. 1999;100:1703–1707.